Evaluation of Aluminum-Coconut Shell Ash (CSA) Composite Using the TOPSIS Method

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Abstract:- Research on the classification of aluminum ash and coconut shell (CSA) composites is of great importance as it has the potential to address important challenges and provide innovative solutions in various fields. First, the help of shell ash as a material in aluminum composites offers a sustainable and environmentally friendly alternative. Coconut shell ash is a by-product of the coconut processing corporation and its use in composites helps reduce waste and minimize environmental impact. By turning this waste into a valuable resource, scientists contribute to circular economy ethic and promote sustainable manufacturing practices. The light weight of aluminum ash and coconut shell composites is another aspect that makes them relevant for research. The combination of lightweight aluminum and low-density coconut ash results in composites that are significantly lighter than traditional materials. This property is particularly sought after in industries such as aerospace, automotive and transportation where weight reduction is critical to fuel economy, efficiency, and overall energy savings. By developing and testing these composites, scientists hope to open the possibility of creating lighter, more efficient structures and components. The high hardness and abrasion resistance of coconut ash devote to increased durability, making these composites suitable for high-performance applications. Through the research, scientists aim to understand the affair between the composition, processing techniques and resulting mechanical properties of aluminum and coconut ash composites. This knowledge can lead to the development of customized composite materials with specific mechanical properties and thus expand their range of applications. Interfacial bonding between the aluminum matrix and coconut shell ash particles is critical to the performance of these composites. Efficient interfacial bonding ensures effective load transfer between the carcass and stiffener, improving strength and stiffness. Researchers focus on exploring and optimizing interfacial bonding mechanisms and techniques to increase the overall performance and reliability of composites. With a better understanding of interfacial behaviours, researchers can develop strategies to maximize the potential of aluminum and coconut shell ash composites. In summary, research on the classification of aluminum ash and coconut shell composites is important to solve durability problems, study lightweight materials, improve mechanical properties, and enhance interfacial bonding. By advancing their knowledge and understanding in that field, scientists aim to enlarge the potential of these composite materials and pave the way for their practical application in various fields. Ultimately, this research will contribute to the development of more durable, better performing, and other efficient materials in the future. Methodology: TOPSIS METHOD: TOPSIS (Perfect Likeness Sequencing Technique) is a multi-criteria decision support method. Rank of materials according to their similarity to the unique solution. The process builds in defining criteria, evaluating alternatives, normalizing data. TOPSIS takes toward account both positive and negative form and permit decision-makers to make comprehensive judgment It presents a systematic approach to choosing the best alternative, considering several criteria and their relative importance. With TOPSIS, decision-makers can make informed agreemen and skilfully prioritize alternatives. The Alternate Parameters are l-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA. Evaluation Parameters: UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. Al-15% CSA ranked first in the material properties compared to others while Al-1100 is ranked last in the material properties compared to others. Al-15% CSA is the best material composition which can be used for many fields compared to others.

Keywords:- *TOPSIS METHOD, Aluminum-Coconut Shell Ash (CSA) Composites, Material Properties*

I. INTRODUCTION

In modern way of life, experts in design and research connect vast importance to the inquiry for light, environmentally friendly, low-priced first-rate and adequate materials. One area of manufacturing that has attracted precise passion is the development of alloy matrix composites (AMCs), in which an appropriate matrix is combined with various reinforcing materials. In the past, most research has focused on the use of conventional coarse reinforcements, but these have proven unsustainable and harmful to the environment. Therefore, scientists have made several attempts to study the use of agricultural waste such as coconut shells, apricot kernels, tobacco stems, and mining slate from rural areas and industry. These unconventional materials are being considered for AMC development due to their favourable interfacial properties and relatively low density compared to aluminum alloys [1]. The microstructure aluminum alloy (Al-SiFe) composite with coconut ash particles were calculated the composite was built by a dual mix molding process, the first mix for 10 minutes and the second mix for 5 minutes at 700 rpm. Several samples were prepared by adding 0-15% by weight coconut shell ash particles (CSAP) and these samples were then analysed for their microstructural and mechanical properties. The desire was to explore the aftermath of the CSAP content on the resulting microstructure and the mechanical behaviours of the composite material [2]. Aluminum metal matrix composites (AMC) is used in transportation, construction which also in advanced applications for defines, aerospace and sports due to extensive ownership internal and external reinforcement response in every physical and thermomechanical properties [3]. A composite material are constructed substance containing two or more physically and/or chemically distinct and suitably arranged phases partitioned by an interface [4]. To meet the diverse necessity of the corporation the focus is constantly on the development of materials and technical tools. Metal matrix composites (MMCs) offer significant advantages due to their desirable setting and are therefore suitable for a wide range of components. The industrial use of a wide range of metal alloys is essential and the constant search for new compositions aims to meet the changing necessity of many industries [5]. Aluminum metal matrix composites (AMCs) are widely adopted for a collection of applications due to their light weight and affordability. Typically, AMCs are made from possession of aluminum (Al) as the matrix material and ceramic as the reinforcement. The presence of ceramic reinforcements limits the deformation of the aluminum matrix under load, ensuring even load distribution throughout the composite. This reinforcement mechanism advances the overall properties of the composite [6]. The development and characterization of composites reinforced along natural fibres and particles has attracted the attention of researchers global due to their improved formability, availability, renewability, cost reduction, increased global environmental campaign therefore stern international sanction for non-compliance [8]. Metal matrix composites (MMCs), which have higher wear with fatigue resistance, greater pliability, increased electric and thermal insulation, and reinforced nanostructures with good abrasion resistance, are a common component of composite materials. Composites offer the best qualities by combining several elements in a beneficial way. The values of net reduction, aspect improvement, greater performance, and cost-effectiveness drove advancements in material development that led from monolithic constructions to composites [14]. The growing appeal for structural components with more life, improved performance, strength-to-weight proportion, and affordability has excited the development of new materials such as composites. Basically, Composites were formed in combining two or more divergent chemical materials, with an interface splitting the components within a 3 -dimensional structure. This combination results in high-caliber properties that differ from the original materials [19]. Aluminum continues to be the dominant matrix material in metal matrix composite (MMC) development due to its wide application and reliability. The use of aluminum-based MMCs with disperse reinforcements has met with great interest in various industries. These composites exhibit outstanding physical and mechanical properties, including excellent wear resistance, high stiffness, long-term durability, controlled thermal expansion, light weight, higher fatigue strength than high stability. This makes them extremely desirable for a variety of applications [18]. The eco-composites are made from non-toxic and biodegradable natural ingredients. Most eco-composites can be recycled through composting, incineration or incineration and consent no residue like fiberglass and carbon composites [21]. Metal Matrix Composites (MMCs) are having a advantage on the production of high performance components in industries such as aerospace, automotive and marine. This is primarily due to their unique properties, including increased strength, stiffness, hardness, modulus of elasticity, reduced heat expansion and improved dry sliding wear performance. These remarkable properties make MMCs extremely desirable for manufacturing parts that require the maximum performance [16].

II. MATERIALS AND METHOD

- **Topsis Method:** A novel fuzzy TOPSIS approach is introduced for the selection of plant locations. This method incorporates linguistic terms represented by fuzzy numbers to evaluate alternative locations and criteria weights. By averaging and normalizing the ratings and weights, comparability is achieved. The development of membership functions for normalized weighted scores employs fuzzy numeric interval arithmetic. Simplification is achieved through the defuzzification of normalized weighted scores. A proximity factor is implying to determine the ranking of alternative locations by considering their distances from both the ideal and negative ideal solutions. The proposed approach considers decision makers' subjective assessments from various perspectives and trade-offs between criteria, enhancing the reliability of decision making [22]. TOPSIS is a widely used for solving decision making (MCDM) problems. It is used in a variety of practical scenarios, including comparing trade performance, assessing financial metrics in specific industries, and making financial investments in advanced manufacturing systems. However, the original TOPSIS method has certain limitations, with most improvement efforts focused on expanding the weighting and enhancing the sensitivity of the R-value. Additionally, alternative formulas, such as the "Miqiezhi" approach, have been proposed to calculate the R-value. Considering the intricate nature of valuation problems, there is a pressing need to develop a more intuitive and simplified approach that elucidates the inherent relationship between the R-value and alternative evaluation. In this study, we introduce a unique modification to the TOPSIS method, termed M-TOPSIS. This innovative approach involves assessing the quality of alternatives by quantifying the distance between alternatives and reference points in the D+D plane. By leveraging this revised methodology, decision-makers can gain a more comprehensive and insightful understanding of the quality and suitability of alternative options [24]. The Ideal-like Order Execution Technique (TOPSIS), first introduced by Hwang and Yoon in 1981, is the second most universally implied and best-known method for (MCDM) multi-criteria decision making [25]. Among the various MCDM approaches (multi-criteria decision making), It is very attractive and is treated to be the second most used method. Many scientists have used his TOPSIS to tackle various simple and complicated problems in various fields. Additionally, researchers have made modifications and extensions to the TOPSIS method to address satisfied unique challenges. The endless development and boost in function of TOPSIS reflect the general advancement and developing use of MCDM approach to clarify a wide range of tasks, from simple to complex [26].

Normalize the decision matrix:

$r_{ij} = x_{ij} / \sqrt{(\sum_{k=1}^{m} x^2_{kj})}$, for $i = 1 - m$; $j = 1 - n$.

$v_{ij} = w_j \times r_{ij}$, for $i = 1 - m$; $j = 1 - n$.

Determine the positive ideal and negative ideal solutions:

$A^+ = \{(\max_i v_{ij} \mid j \in K_b), (\min_i v_{ij} \mid j \in K_c)\}$,

$A^- = \{(\min_i v_{ij} \mid j \in K_b), (\max_i v_{ij} \mid j \in K_c)\}$,

Obtain the distances of the existing alternatives from the positive ideal and negative ideal solutions:

$S^+_i = \sqrt{(\sum_{j=1}^{n} (v_{ij} - v^+_j)^2)}$, for $i = 1, \ldots, m$.

$S^-_i = \sqrt{(\sum_{j=1}^{n} (v_{ij} - v^-_j)^2)}$, for $i = 1, \ldots, m$.

Calculate the relative closeness to the ideal alternatives:

$RC_i = S^-_i / (S^+_i + S^-_i)$, for $i = 1, 2 - m$

These are the formulae used in the TOPSIS method **[31].** This result shows that there is a large difference in the decision-making outcomes of decision producer with different risk attitudes. The examples provided illustrate the application of this approach and demonstrate the selection of the best alternatives in risk-averse, risk-neutral, and risk-on attitudes. This conclusion highlights the potential advantages of the proposed method in terms of TOPSIS analysis, exclusively for decision makers who need to minimize decision risks and make optimal decisions. Overall, this approach serves as a valuable tool for decision makers who want to cut down danger and settle the economical alternative **[32].** The field of multi-criteria decision making has grown rapidly over the concluding few decades, driven by the growing needs and dynamics in the corporate sector. The field has seen significant developments and advances in response to the changing industry decision-making scene **[27].**

In today's dynamic global marketplace, companies all over the world face rising competition and growing consumer demand for quality products at competitive prices. This risky business environment has created hurdles in the manufacturing and production processes for companies turned to meet customer expectations while optimizing costs **[23].**

- ***Al-1100:*** It is known for its excellent corrosion resistance, high electrical conductivity, and good formability. This alloy has relatively low strength compared to other aluminum alloys, but offers excellent machinability and weldability. It is generally used in applications that require high thermal and electrical conductivity, such as B. heat exchangers, fins, and electrical conductors.
- ***Al-5% CSA:*** This composite material combines the lightweight and cost-effective properties of aluminum with the added benefits provided by the incorporation of CSA. The presence of CSA reinforcement enhances the properties of the composite, like wear resistance, strength, and stiffness. It offers potential applications in industries where lightweight materials with improved mechanical performance are desired, such as automotive and aerospace sectors.
- ***Al-10% CSA:*** It is referring to aluminum alloy composites containing 10% coconut shell ash (CSA) particles as reinforcement. The function. mechanical properties of this complex compared to pure aluminum make it suitable for a collection of applications. Adding 10% CSA increases strength, hardness and wear resistance while maintaining the lightness of aluminum. Industries such as construction, marine and sporting goods can benefit from using his Al-10% CSA composites for structural components and high-performance applications.
- ***Al-15% CSA:*** It is an aluminum alloy composite made with 15% coconut ash particles (CSA) and is said to improve the technical properties of the material. Compared to low CSA composites, Al-15% CSA offers even greater improvements in strength, stiffness, and wear resistance. This makes it ideal for applications that require higher load capacity and better overall performance. Industries such as automotive, aerospace and engineering can benefit from the use of Al-15% CSA composites in components that require a careful balance of strength, light weight, and durability. With a 15% CSA reinforcement, this composite material attempts a reliable solution to meet the demanding demands of these industries.
- ***Al-20% CSA:*** Al-20% CSA is a name for an aluminum alloy composite that has been strengthened with 20% coconut shell ash (CSA) particles. This composite has exceptional mechanical qualities with a high CSA content, including improved strength, toughness, and wear resistance. For systems where high strength and durability are crucial, the incorporation of 20% CSA offers greater reinforcing and load bearing capability. Al-20% CSA alloys are advantageous for sectors including automotive, aerospace, and defence that need robust yet lightweight materials.
- ***UTS (N/mm2):*** It is measured in N/mm² (newtons per square millimeter) and serves as an important indicator of a material's strength and resistance to external forces. UTS represents the ability of a material to withstand tensile (pulling) forces without deformation or failure. Higher UTS values indicate stronger materials that can withstand higher stresses before reaching their breaking point. Understanding UTS is important in various

industries including engineering, construction, and manufacturing as it helps determine the suitability and reliability of materials for specific applications. By estimating the UTS, engineers and designers can ensure the structural integrity and safety of components and structures under different load conditions.

- **Toughness (J/mm3):** It is material's ability to absorb energy before it breaks. So, it is usually expressed in units of J/mm3 (joules per cubic millimeter). High hardness materials can withstand impact and deformation and are not comfortably crushed. It refers to a material's resistance to cracking and its ability to absorb and dissipate energy when subjected to external forces. Material toughness is important in applications subject to dynamic or sudden loading, such as: B. Crash structures for vehicles, sporting goods, and industrial machinery. Higher hardness values indicate a material that can absorb more energy and withstand more stress, making it convenient for applications where durability and impact resistance are required.
- ***Density(g/cc):***Measured in grams per cubic centimeter (g/cc), is a property that describes the substance's mass per unit volume. It points out how dimly packed the particles or molecules of a material are. A higher density means that the material is more compact and has more mass for a given volume. Different materials can have greatly different densities, which can affect their applications. For example, low-density materials such as light metals or foams are preferred in applications where weight reduction is a consideration while high-density materials such as metals can be used in structural applications outstanding to their strength and durability.
- ***Wear rate (10-3 mm3 /m):*** Wear rate, also known as wear rate or wear loss, refers to a amount of material loss or degradation that occurs over time due to mechanical interactions between two relatively moving surfaces. Quantify the amount of material detached or removed from a surface per unit time under specified operating conditions. This provides valuable insight into the durability, reliability and performance of materials, components and systems subjected to sliding, rolling or frictional contact**.** The wear rate is affected by several factors such as the type of material in contact, surface roughness, applied load or pressure, sliding or rotational speed, temperature, lubrication, and the presence of contaminants or abrasive particles. Various wear mechanisms can matter material loss.
- ***Coefficient of friction:*** The coefficient of friction, also referred to as the friction coefficient, is a dimensionless value that quantifies the extent of friction between two surfaces that are in contact. It represents the ratio between the force needed to overcome the resistance caused by friction between the surfaces and the normal force exerted on the surfaces, pushing them together. This coefficient has a important role in characterizing and predicting in the behaviour of frictional interactions in various applications and industries. It serves as a fundamental parameter in disciplines such as engineering, physics, and materials science. The coefficient of friction can be shows into two main types: static and dynamic. Laboratory tests using standard friction measurement techniques are used to determine the coefficient of friction. Common methods include the slope test, which measures the angle at which an object begins to slide and relates the frictional force to applied normal force and tilt angle. It aids design along with engineering by definitive the forces and torques required to move objects and components, designing efficient braking systems, and permissive part evasion.

III. RESULT AND DISCUSSION

Table 1 presents the material selection for aluminum-coconut Shell Ash (CSA) Composite for Analysis using the TOPSIS Method. The parameters considered include UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials listed in the table include Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA.

Figure 1 Shows that the Al-15% CSA has the highest benefits in properties than any other alternatives. Al – 1100 has the lowest benefits than any other materials listed there.

Table 2 shows the Normalized Data for aluminum-coconut Shell Ash (CSA) Composite using the TOPSIS Method UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA normalized data.

Figure 2 shows the Normalized data for WSM Alternative: UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA; the Al-5% CSA is highest in Wear rate, Al-1100 is highest in Wear rate, Al-10% CSA is highest in Wear rate, Al-15% CSA is highest in Toughness, Al-20% CSA is highest in Coefficient Friction.

Table 3 provides the weights utilized for the analysis, where equal weights are assigned to all parameters

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Table 4 for WSM Alternative: UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA; the Al-5% CSA is highest in Wear rate, Al-1100 is highest in Wear rate, Al-10% CSA is highest in Wear rate, Al-15% CSA is highest in Toughness, Al-20% CSA is highest in Coefficient Friction.

Figure 4 shows that Weighted Normalized Decision Matrix for aluminum-coconut Shell Ash (CSA) Composite; UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA;

Table 5. Positive matrix for the aluminum-coconut Shell Ash (CSA) Composite are the data listed above. UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA;

Table 6. Negative matrix for the aluminum-coconut Shell Ash (CSA) Composite are the data listed above. UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA

Table 7. shows that the Si+ and Si- and Cci of the aluminum-coconut shell ash (CSA) composites UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction. The materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA.

Figure 5 represents the values of the UTS (N/mm2), Toughness (J/mm3), Density(g/cc), Wear rate (10-3 mm3 /m), Coefficient of friction for the materials are Al-1100, Al-5% CSA, Al-10% CSA, Al-15% CSA, Al-20% CSA; shows that the Cci is highest for the Al-15% CSA Composite.

Table 1: Ranking of aluminum-coconut Shell Ash (CSA) Composite

RANKING OF ALUMINUM-COCONUT SHELL ASH (CSA) COMPOSITES					
Composites	**UTS (N/mm^2)**	**Toughness (J/mm^3)**	**Density(g/cc)**	**Wear rate (10^{-3} mm^3 /m)**	**Coefficient of friction**
Al-1100	104.00	17.10	2.72	4.07	0.41
Al-5% CSA	128.00	19.13	2.66	3.76	0.31
Al-10% CSA	157.00	23.91	2.60	3.12	0.26
Al-15% CSA	174.00	26.92	2.47	2.44	0.29
Al-20% CSA	151.00	21.12	2.40	2.69	0.39

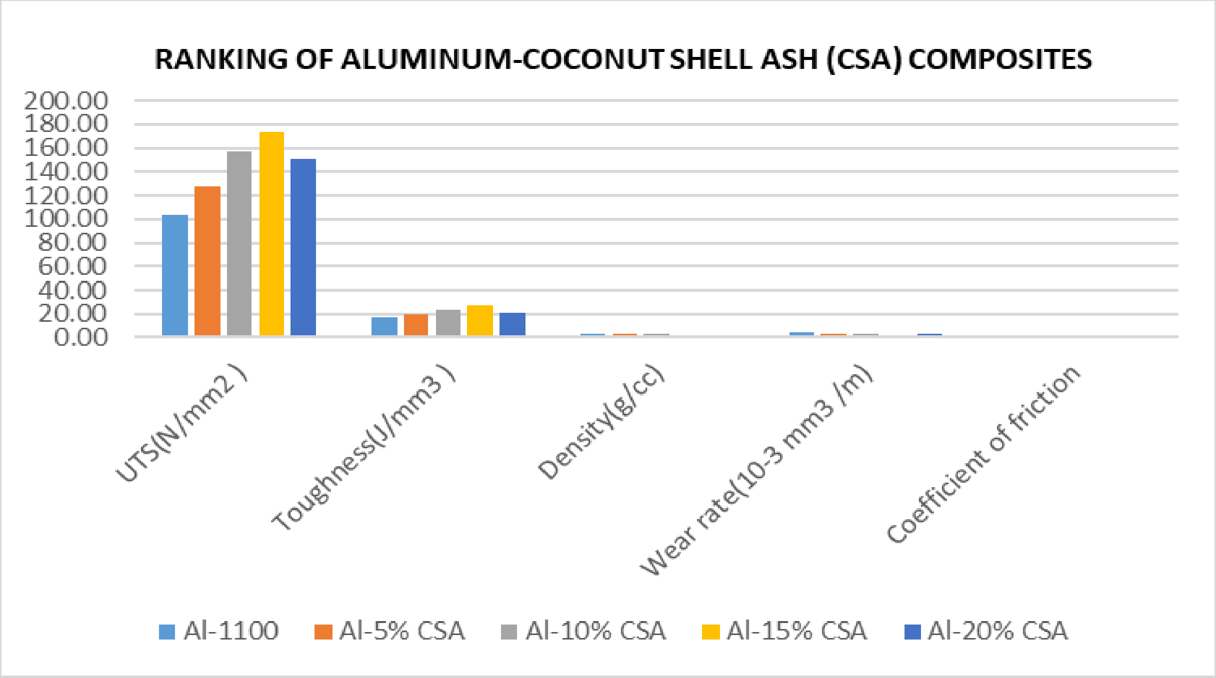

Fig. 1: Properties of Aluminum-coconut Shell Ash (CSA) Composite

Table 2: Normalized Matrix for aluminum-coconut Shell Ash (CSA) Composite

COMPOSITES	**NORMALIZED MATRIX**				
Al-1100	0.32	0.35	0.47	0.56	0.54
Al-5% CSA	0.40	0.39	0.46	0.51	0.41
Al-10% CSA	0.48	0.49	0.45	0.43	0.35
Al-15% CSA	0.54	0.55	0.43	0.33	0.39
Al-20% CSA	0.47	0.43	0.42	0.37	0.51

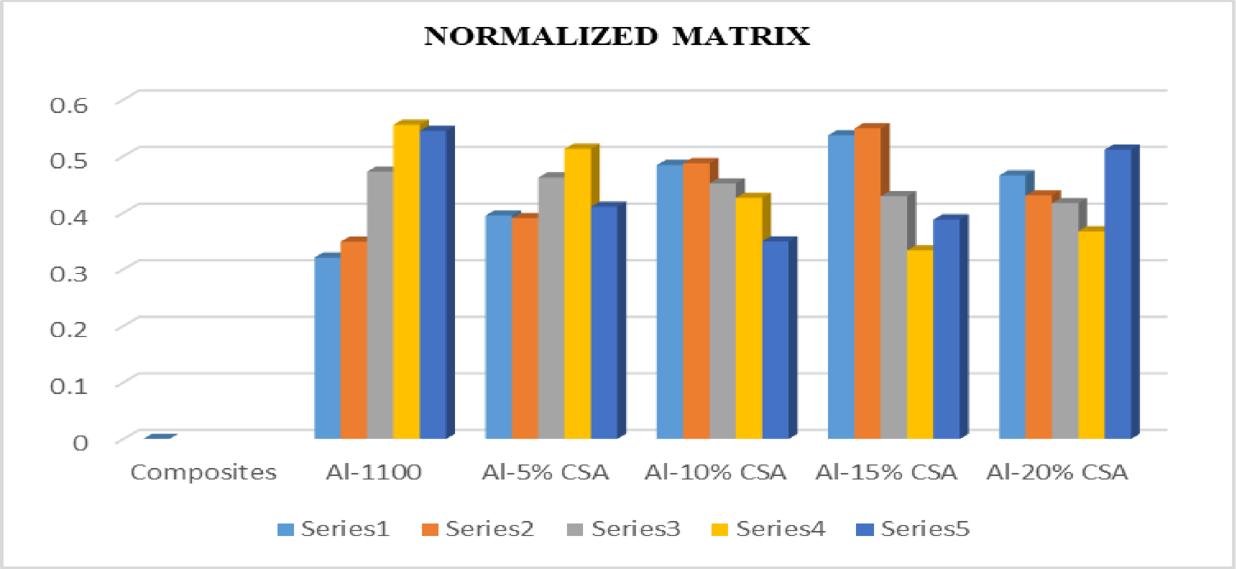

Fig. 2: Normalized data for Automotive brake disc material selection

Table 3: Weightages of the Materials

Composites	**WEIGH MATRIX**				
Al-1100	0.2	0.2	0.2	0.2	0.2
Al-5% CSA	0.2	0.2	0.2	0.2	0.2
Al-10% CSA	0.2	0.2	0.2	0.2	0.2
Al-15% CSA	0.2	0.2	0.2	0.2	0.2
Al-20% CSA	0.2	0.2	0.2	0.2	0.2

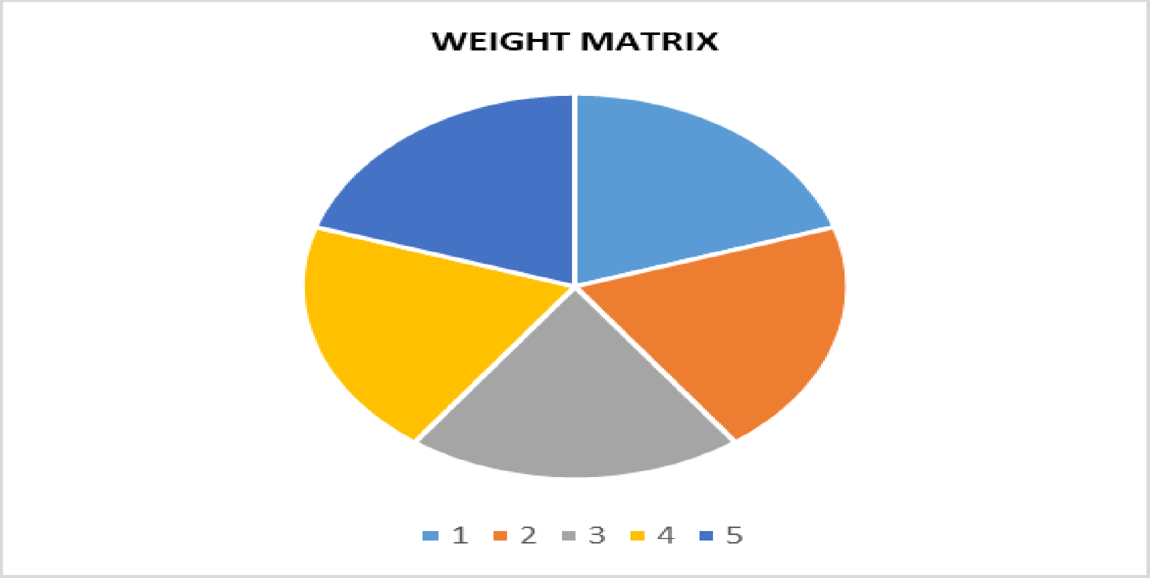

Fig. 3: Provides the weights utilized for the analysis,

Table 4: Weighted normalized decision matrix

COMPOSITES	WEIGHTED NORMALIZED MATRIX				
Al-1100	0.064	0.070	0.095	0.111	0.109
Al-5% CSA	0.079	0.078	0.092	0.103	0.082
Al-10% CSA	0.097	0.098	0.090	0.085	0.070
Al-15% CSA	0.107	0.110	0.086	0.067	0.078
Al-20% CSA	0.093	0.086	0.083	0.073	0.102

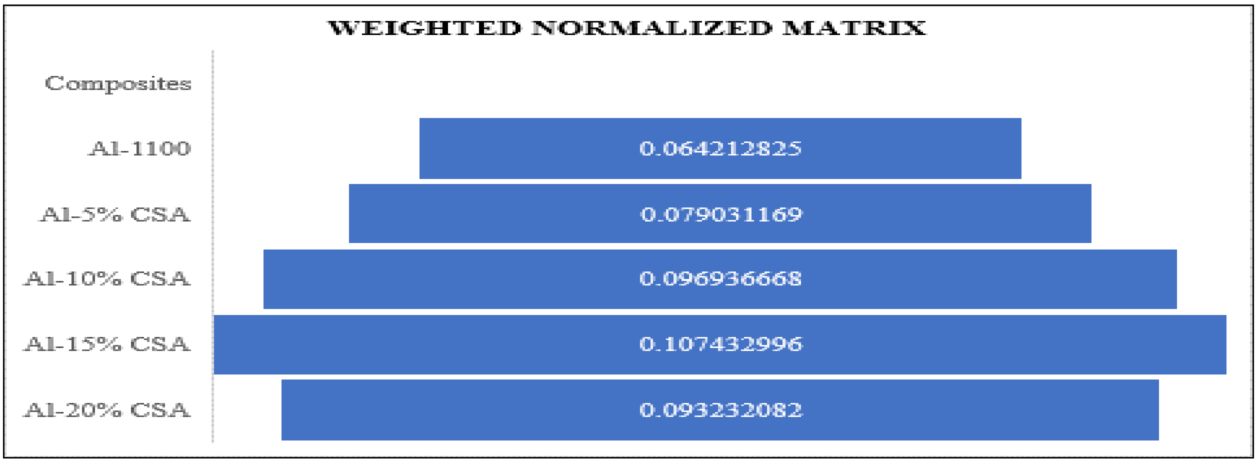

Fig. 4: Weighted Normalized Decision Matrix for aluminum-coconut Shell Ash (CSA) Composite

Table 5: Positive matrix of the aluminum-coconut Shell Ash (CSA) Composite

Composites	POSITIVE MATRIX				
Al-1100	0.107	0.110	0.083	0.067	0.070
Al-5% CSA	0.107	0.110	0.083	0.067	0.070
Al-10% CSA	0.107	0.110	0.083	0.067	0.070
Al-15% CSA	0.107	0.110	0.083	0.067	0.070
Al-20% CSA	0.107	0.110	0.083	0.067	0.070

Table 6: Negative matrix for the aluminum-coconut Shell Ash (CSA) Composite

Composites	**NEGATIVE MATRIX**				
Al-1100	0.064	0.070	0.095	0.111	0.109
Al-5% CSA	0.064	0.070	0.095	0.111	0.109
Al-10% CSA	0.064	0.070	0.095	0.111	0.109
Al-15% CSA	0.064	0.070	0.095	0.111	0.109
Al-20% CSA	0.064	0.070	0.095	0.111	0.109

Table 7: Si+ and Si- and Cci of the aluminum-coconut shell ash (CSA) composites

Composites	**Si+**	**Si-**	**Cci**
Al-1100	0.08	0.00	0
Al-5% CSA	0.06	0.03	0.363006
Al-10% CSA	0.03	0.06	0.712816
Al-15% CSA	0.01	0.08	0.908949
Al-20% CSA	0.04	0.05	0.546222

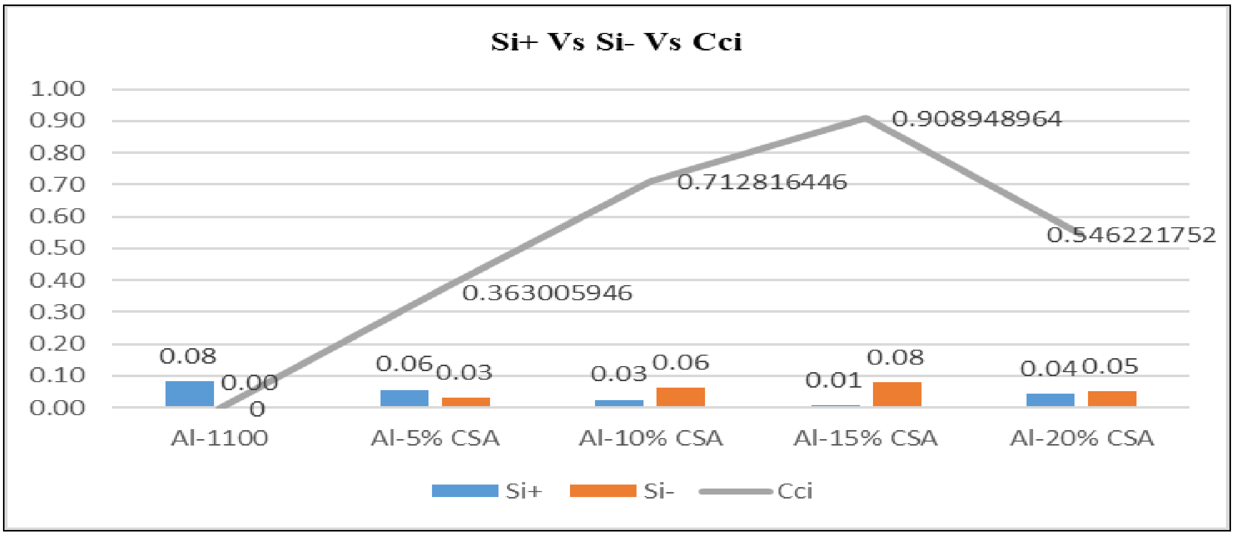

Fig. 5: Si+ Vs Si- Vs Cci for aluminum-coconut Shell Ash (CSA) Composite

Table 8: Rank of the different aluminum-coconut Shell Ash (CSA) Composites

Composites	**RANK**
Al-1100	5
Al-5% CSA	4
Al-10% CSA	2
Al-15% CSA	1
Al-20% CSA	3

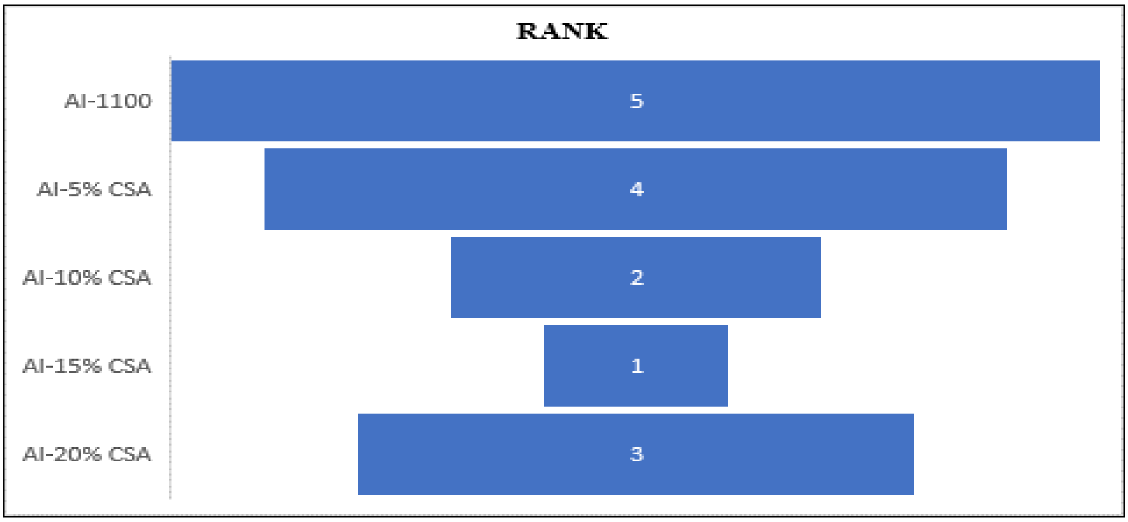

Fig. 6: Rank of the aluminum-coconut Shell Ash (CSA) Composite.

IV. CONCLUSION

Aluminum Coil Composites (CSA) is a fascinating R and D area in materials science. These composites combine the light weight and versatility of aluminum with the unique properties of coconut ash to create a material with a wide range of applications. Coconut shell ash, obtained from waste from the coconut processing industry, has several beneficial properties as a composite reinforcement. First, coconut shell ash is widely available as a by-product, making it a sustainable and environmentally amicable solution. This waste utilization not only reduces the environmental impact, but also contributes to the circular economy. One of the main advantages of aluminum ash composites made from coconut shells is their light weight. Alone aluminum is known for its low density, and when combined with coconut ash, the resulting composite material is much lighter than traditional materials In modern way of life, experts in design and research connect vast importance to the inquiry for light, environmentally friendly, low-priced first-rate and adequate materials. One area of manufacturing that has attracted precise passion is the development of alloy matrix composites (AMCs), in which an appropriate matrix is combined with various reinforcing materials. In the past, most research has focused on the use of conventional coarse reinforcements, but these have proven unsustainable and harmful to the environment. this approach serves as a valuable tool for decision makers who want to cut down danger and settle the economical alternative**.** The field of multi-criteria decision making has grown rapidly over the concluding few decades, driven by the growing needs and dynamics in the corporate sector. The field has seen significant developments and advances in response to the changing industry decision-making scene**.**

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